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Correspondence.—Wishing to make this Journal a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of these subjects a pleasure or a profession.

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[OFFICIAL NOTICE.]

American Gas Light Association.

OFFICE AMERICAN GAS LIGHT ASSOCIATION,
142 CHAMBERS STREET, NEW YORK.

To the Members of the Association:

The Ninth Annual Meeting of the American Gas Light Association will be held in Boston, on Wednesday, Oct. 19th, and continue for three days.

Members of the Association are earnestly requested to prepare papers upon the many topics of general interest, to be read at that meeting. The Secretary counts upon the active co-operation of the members in his efforts to render the meeting of marked value.

WM. HENRY WHITE,
Secretary.

Volume IV. of the Proceedings of the American Gas Light Association, which embraces reports of the meetings held in 1879–80, has just been published. Two copies of the same have been mailed to each member of the Association, and further copies can be obtained by addressing the Secretary.

GENERATOR FURNACES.

It may be admitted, without any tabulated display of figures, or any long-drawn argument, that the ordinary old-fashioned method of heating benches requires much more fuel than ought to be expended for the amount of work done. But the question that remains still (to a great extent) unanswered is, "What shall be substituted for the old method of firing?" The only legitimate answer that can be made to this question is, "Generators, or gas furnaces."

This is a general term, and embraces a large number of so-called systems. These systems vary in name, much more on account of the name of the "inventor," or, more properly speaking, the arranger of the parts, than they do in the underlying principles involved.

In no country has the practical investigation and application of the principles involved, been more thoroughly or scientifically developed than in Germany. Years ago the gas managers of Germany began the investigation which led to such a multitude of devices, that it was thought best to appoint a commission to go into the whole matter, and report to the German Gas Light Association. The men who composed this commission were eminent in their profession, and well-known outside of their own land. They were Dr. Schilling, of Munich; Mr. Simon Schiele, of Frankfort; and Mr. E. Grahn, of Essen, and they called to their assistance the skillful and accomplished chemist, Dr. Bunte.

They were engaged for two years, and they classified all of the generators in two classes, viz., the slit generator, and the grate generators. They tried repeated experiments, with different kinds of coke, and although the limits of this article do not permit the giving of the details of the results obtained; still, in a general way, it was found that it was generally best to have a generator for each bench. That in the slit generators some kinds of coke, the clinker of which fused easily, worked very well; while with cokes whose clinker was less fusible, an arch would form over the slit which, in time, became very troublesome. The introduction of steam reduced the trouble in this respect, but it was found that each kind of coke required its own special amount of steam. The destruction of the fire-brick was also found to be prevented by the use of a proper amount of steam. There is a question in the minds of many if it is a good plan to maintain a heat at the bottom of the furnace that shall always be high enough to melt the slag and let it run through the slit, with the aid occasionally of a little poking by the fireman. This depends altogether upon the coke used, and the ease with which its slag melts. The use of steam serves to preserve the material of which the furnace is constructed; but the more fusible the cinder is the more destructive it is to the fire-brick of the generators. Many generators may work very well for a while, but a change of coal or lack of attention renders them almost unavailable.

The Commission of the German Association found that with generators having a grate instead of a slit any kind of coke could be used, with a proper supply of steam; but that the amount of steam required varied with the different kinds of coke. The object being, in this case, to prevent the melting of the cinders, if too little steam is used, the melting is only partially prevented.

If too much steam is used, the cooling effect upon the generator is too great, the decomposition of the steam, and the reduction of carbonic acid to carbonic oxide is incomplete, and the production of combustible gases ceases.

The amount of steam required for the different cokes experimented with was found to be as follows –

For 100 lbs. of	Zwickau coke	.....	79	lbs. of	steam.
" 100 "	Upper Silesian coke	.....	71	"	"
" 100 "	Saarbruck "	.....	71	"	"
" 100 "	English "	.....	70	"	"
" 100 "	Westphalian "	.....	53	"	"
" 100 "	Bohemian "	.....	49	"	"

With the above proportions of water the residual from combustion was principaliy ashes.

The report closes with the remark that the grate generators with steam combine facility of working, durability of material, and superiority of heating power. It is of the first importance that a proper thickness of fuel should always be maintained, (as a mininimum, about thirty inches is recommended) and that all infiltration of air through the brickwork into the combustion chambers should be prevented as much as possible; and hence the draft should be properly regulated so as not to have much vacuum in the ovens. The amount of fuel consumed by the various generators in use in Germany varies from 14 to 20 per cent.; but it must be borne in mind that this is a percentage by weight, and not the percentage of the coke made. When they say that they use 15 per cent., they mean that it takes 15 pounds of coke to carbonize 100 pounds of coal. This is a better and more accurate way of stating the relation between work done and the material required to do it than our system of percentage of "coke made," for the latter term is always liable to be indefinite.

Thus far we have simply spoken of the generators; but there is still another point in connection with this matter that affects the consumption of fuel, viz., the recuperation or the heating of the air which is to unite with the generator gases at the proper point in the bench, and to do the work of carbonization. The heat for this purpose should not be robbed from the fire in the generator, but should be derived from the waste gases on their way to the chimney. A proper system of recuperation makes a saving of from one and a-half to two per cent. (by weight, as before,) in the fuel used. This seems small in amount when glanced at; but if we make the calculation, each one for himself, it will be seen that two pounds of coke for every hundred pounds of coal carbonized amounts to quite a sum in the course of a year, and is of sufficient value to pay the interest on the extra cost for constructing the recuperator and leave something for profit besides.

Aside from the question of how to utilize tar and ammonia water, there is no more important problem before us to-day than that of making the most possible from that other important residual—*coke*.

THE GAS INSTITUTE.

The British Association of Gas Managers has held its last meeting and, judging from the papers read and the discussions thereon, already received, it appears to have been the most successful meeting held since the organization eighteen years ago. The attendance was large, and more interest than usual seems to have been exhibited by the members. The papers read were of a high order, and were well received and ably discussed. One of the more important features of the meeting was the founding of the Birmingham medal, to be given yearly to any person who, in the opinion of the trustees has done most to develop or improve anything relating to the manufacture or distribution of gas.

After eighteen years of constantly increasing usefulness and progress, the British Association of Gas Managers passes into a new and extended form of organization. Retaining all that it has of good, it now adds to its sphere of usefulness a new department, viz., that of "Associates." This class of members are defined as follows—

"Associates shall be persons holding a responsible position in gas works, or pupils of Gas Engineers, and persons whose pursuits constitute branches of Gas Engineering, or who are otherwise qualified to assist in promoting the objects of the Institute. Managers or Secretaries shall also be eligible, and may apply for election under this rule."

This is one of the principal changes. The organization remains very much as it was before. The idea of the committee has been to extend the usefulness of the Society, and to give to young men every opportunity for fitting themselves for their profession that can be derived from association, contact, and acquaintance with the older members of the fraternity.

The Institute is on a broad and catholic basis. Its members are all over the world, and in every clime; and it is most sincerely hoped and expected that every one will contribute something to the general fund of information which shall, as time goes on, make a record of practical experience and theoretical and scientific investigation of incalculable value. We bid the Gas Institute "God speed."

OBITUARY.

Henry Cartwright.

It is our painful duty to announce to the Fraternity the sad news of the tragic death of Mr. Henry Cartwright, President of the Penn Gas Coal Company, which deplorable event occurred on Thursday, June 30th. On the morning of that day, Mr. Cartwright, who was accompanied by Mr. Ford and wife, and Samuel T. Billmeyer, secretary of the coal company, were descending the gravity road (forming part of the Bell's Gap Railroad, which runs from Bell's Mills, a point about 8 miles north-east of Altoona, Pa., up into the mountains, where the mines of the Bell's Gap Coal Company are located), on a small truck. About half-way down the mountain there was a wooden tramway, used by a lumber company, and crossing the railroad. For some reason this tramway had not been removed, nor had a signal of danger been put out. The party on the truck did not notice the obstruction until they rounded a curve close upon it, and the truck struck the tramway with great force, throwing off all the occupants. Mr. Cartwright was thrown in front, and the car ran over him, inflicting such severe injuries that death ensued shortly after.

Mr. Cartwright was born in the city of Philadelphia, and was in the fifty-eighth year of his age. Besides being President of the Penn Gas Coal Company, Mr. Cartwright was a director in the American Meter Company, and had acted as vice-president of that company from the date of its formation, in 1863, up to March 1st, 1875. He was also a prominent member of the American Gas Light Association, and at the meeting held in Brooklyn, Oct. 21st, 1874, was elected a member of the Executive Committee of that Association, which position he held up to the time of his death.

It would seem to be quite unnecessary for us at this time to speak of Mr. Cartwright's long and successful career in connection with the gas interests of this country, with which he was so long identified. He was an active, liberal and progressive man, and his loss will be very keenly felt by those with whom he was associated in close business relations, as well as by the Fraternity at large.

At a special meeting of the Board of Managers of the Franklin Institute, held July 2d, 1881, the following resolutions were adopted—

Resolved, That the Board of Managers of the Franklin Institute record, with deep sorrow, the sudden death, on the 30th of June 1881, of their fellow-member, Henry Cartwright, Vice-President of the Institute.

Resolved, That the long and faithful services of Mr. Cartwright in the Institute contributed greatly to its usefulness and prosperity, and, coupled with his genial disposition, endeared him to his fellow-members.

Resolved, That while living he was an active and useful citizen, illustrating by his example what was right and good, and now that he is dead that example should continue to speak for the guidance of those who follow.

Resolved, That we sincerely sympathize with his family in their great bereavement, and invoke for them those consolations which are promised to the widow and the fatherless.

Resolved, That as a testimonial of our respect, we will attend the funeral in a body.

D. S. Holman, *Actuary.* William Helme, *Chairman, pro tem.*

Population and Temperature.

A census bulletin shows the distribution of population in the United States in accordance with temperature. Arranging it in groups by five degrees of mean annual temperature, it is found that no less than 98 per cent. of the total population live between lines marked by 40 and 70 degrees F. The cotton region is above 55 degrees, sugar and rice above 70 degrees, and tobacco between 50 degrees and 60 degrees. The prairie region of the Mississippi valley lies almost entirely below 55 degrees, while the great wheat region of Minnesota and Dakota is mainly below 40 degrees of mean annual temperature. The highest maximum temperature is in south-western Arizona and south-eastern California. Of the entire population, 89 per cent. are found in the classes which have a maximum temperature between 95 and 105 degrees. In considering minimum temperature, it is seen that 95 per cent. of the inhabitants of the United States live between the lines of thirty-five degrees below zero, and ten degrees above, for extreme cold.

From this it is evident how population tends to increase in regions rather north of medium temperature; or, more correctly speaking, between isotherms of low degree.—*Sci. Am.*

Lubricating Gears.—Where a mill is driven by mortise gearing, it has been recommended to use a mixture of pulverized chalk and linseed oil for lubricating purposes. It is said that this mixture is much better for wooden cogs than oil, tallow or flour. The chalk for this mixture should be first pulverized, and then sifted through a fine sieve.—*Sci. Press.*

[From the London "Journal of Gas Lighting."]

Eighteenth Annual Meeting of the British Association of Gas Managers.

INAUGURAL ADDRESS OF THE PRESIDENT, CHARLES HUNT, ESQ., M.Inst.C.E., OF BIRMINGHAM. Delivered Tuesday, June 14, 1881.

It is my pleasing duty to return you my sincere thanks for having placed me in the honorable position of President of an Association of such great and growing importance, which year after year continues to establish new claims upon our attachment, and is destined, as I hope and believe, to furnish yet more convincing proofs of capacity for development and useful work.

If the pioneers of our industry could be with us to-day, I venture to think that with the gratification they would experience at witnessing this assembly, representative as it is of a growth such as the most sanguine of them could never had anticipated, would be mingled a feeling of justifiable pride at the position now assigned, by the almost unanimous voice of entire communities, to the system of artificial illumination which they so potently called into existence. For it was their lot to conduct a difficult and doubtful enterprise to questionable success; to lavish their resources of time, ingenuity, and money for a very inadequate return. Theirs, it is true, was the satisfaction that belongs to those who are permitted to follow the bent of their genius; to sow the seeds of new industries; and to watch for the first signs of life in the quickened germ; but for a later period was reserved the spectacle of the abundant harvest. We of that period are privileged to dispense the advantages resulting from those early efforts; and, let us hope, to lay the foundations of further and more important benefits.

As a natural consequence of the position which coal gas has acquired as a necessity of modern life, it has followed that the arrangements for its supply have become matters of growing public concern. They have come to rank almost with those for the supply of the commonest necessaries, and are canvassed with an eagerness second only to that which is provoked by the incidence of taxation. Such being the case, it is not to be wondered at that a conflict should have arisen between the representatives of private enterprise on the one hand and of local self government on the other, the ultimate termination of which has hitherto been found only in the assumption by the latter of the duties and responsibilities initiated by the former. This very general result, it is almost needless to say, has been greatly accelerated, if not entirely brought about, by that extended application, contemporaneously with the advance in the fortunes of gas companies, of the principle of popular representation as applied to municipal government, which dates from the passing of the Municipal Corporations Reform Act of 1835. That act, which has not inaptly been called the Great Charter of the Municipalities, could not fail of being the precursor of notable changes, although it was not to be expected that these would be immediately apparent. The free institutions thus created were not all at once to be endowed with vigorous manhood. They were destined to encounter all the perils of immaturity and inexperience, and won their way slowly, though surely to public confidence. But time has amply vindicated the wisdom of their authors. If local self-government has not yet ceased occasionally to provoke a taunt from those whose sense of ridicule is stronger than their sense of patriotism, at least it must be admitted to have contributed most materially to the comfort and happiness of the population of our great towns.

It does not, however, fall within the scope of the observations that I am privileged to address to you, to dwell upon either the merits or demerits of municipal institutions, although I may be permitted to pay a passing tribute to the eminent services rendered to their cause by a former chairman of a gas committee. I allude, as may be supposed, to the Right Hon. Joseph Chamberlain, M.P. The mention of this gentleman's name will appear to be none the less appropriate from the fact that he may be said almost to have commenced his public career as a gas administrator. It is not too much to say that by his example and precept the work of local administration has acquired new significance and strength, and a breadth and dignity hitherto to a great extent lacking. If hereafter it should be determined still further to extend the power and authority of Municipal Councils, and so relieve the already overburdened national legislature, such a result will have been in no small degree owing to the spirit infused into their deliberations by the right honorable gentleman and his coadjutors.

It is upon the final aspect of the struggle to which I have referred—or that in which the gas undertakings, after what may be described as a vicarious existence, have passed into the hands of the local authorities—that I desire, in the first place, to say a few words, being emboldened to take this course from the circumstance that, as regards the office which I have the honor to occupy, this happens to be the first time that your choice has fallen upon the representative of a corporation. The subject is one that it cannot be desirable should be approached in any spirit of partisanship, for this would be foreign to the work of the Association Neither do I feel myself fitted for such a task, my present experience and associations being somewhat at variance with those of earlier and perhaps more impressionable years. But in the consideration of certain principles involved in this change of ownership, and, above all, of the prospects of gas lighting in the hands of its new masters, all of us—representatives of companies and corporations alike—are interested, and are able to meet upon common and neutral ground.

It may, then, be accepted as no slight testimony to the strength and character of popular representation, that it should be intrusted with the conduct of important industrial and commercial enterprises; and especially will this be felt when it is recollected that there exists in this country no precedent for the assumption, by the governing bodies, of the functions and position of private traders. Nor could such assumption be justified, except upon the high ground of public convenience and advantage. Not that the gas companies had in any way failed in the performance of the duties they had undertaken. On the contrary, they had served the public faithfully and well. The had performed all, and occasionally more than all of their statutory obligations. The convictions, under their penal clauses, throughout the entire kingdom had scarcely amounted to as many during the number of years that they had been in force, as are obtained in a single year against the law-loving and law-abiding citizens of Birmingham under the Acts for the Prevention of Smoke. It could have been through no fault of theirs, but rather the reverse, that the article they supplied had grown from exceptional into almost universal use. It could have been through no fault of theirs, but rather the reverse, that they ultimately became prosperous. Neither could it have been justly charged against them that there had sprung up an impatience of privileged monopolies, increasing in intensity with the growing strength of the governing bodies. Nevertheless, it is in consequence of this combination of results that we find ourselves in contemplation of a movement which, in a comparatively short space of time, has, in most of our great centers of population, displaced the companies in favor of the local authorities. And thus far there has been no reason to regret the change. On the part of the corporations there has been uniformly manifested a disposition to pay a fair, and even a full price for the property they were desirous of purchasing, and this has been met by the companies with a patriotic willingness to accept such terms; the result being that to the public have been secured the benefits of co-operation in its widest and most significant sense, and for gas lighting what may fairly enough be regarded as almost the highest pinnacle of importance.

I have said that the justification for these transfers is furnished by their promotion of the public convenience and advantage. For example, the desirability of securing to one central authority the undivided control of the thoroughfares would seem to be self evident; yet some are inclined to pay little heed to the objections urged by local authorities to the breaking up of the streets by an independent, and in some respects a rival power. The inconveniences arising therefrom they regard as imaginary; the grievance as sentimental, inasmuch as Parliament has provided in its enactments for the restoration, at the cost of the companies, of all damage occasioned by them. But having been myself the instrument, during the last few years, and under both *regimes*, of about as much of this particular kind of "street disturbance" as falls to the lot of most gas engineers, I am enabled, perhaps in a peculiar degree, to bear testimony, not alone to the somewhat trying conditions under which the work of a road-mender has to be carried on, but also to the advantage, from an economical point of view, of that unity which is or ought to be secured when those whose operations are of so divergent a character no longer rank as representatives of opposing interests, but are engaged side by side in one common service. At the same time I feel bound to admit that in my own case one bone of contention still remains. I have never been able to persuade my esteemed friend, the Borough Surveyor of this town, to relinquish, in the interests of the gas undertaking, the use of that pernicious instrument, the steam roller!

It is commonly objected that the ruling motive of corporations in making these acquisitions has been one of profit. They would not, it is alleged, have sought to displace the companies had gas manufacture continued unremunerative. It was only as this became otherwise that they awoke to a sense of their responsibilities. There is much of truth in this, but of truth that cannot be, in any strict sense, a reproach. Even assuming the opposite of what we know to have been the case—namely, that the governing bodies were, from the first, fitted to undertake the management of the gas supply—their hesitation, in all but a few instances, was not without justification. We all know that coal gas was, for a lengthened period, upon its trial. It was held in doubtful esteem. It was looked upon with coldness, amounting almost to aversion, by men of high scientific attainments; and was even in some degree of danger from the favor with which they regarded a more brilliant and attractive rival. That danger has not ceased to recur, and was probably never more real than now; but then its influence to-day is more than counterbalanced by an assurance as to the future of gas lighting, solidly based upon a more just appreciation of its resources—as yet

imperfectly developed—and of the strength and vigor to which it has so rapidly attained. But in the absence of such assurance, the materials for which are of a comparatively recent growth, it would have been both imprudent and impolitic to have adventured the public money in the purchase of these undertakings. It would have savored too much of speculation—a course which, in regard to public funds, all are agreed in condemning. The employment of such funds, however, for purposes of general utility—as, for example, the establishment of the postal system or the purchase of the telegraphs—has, with equal unanimity, been recognized as not only perfectly legitimate, but even necessary to the public welfare. Nor can it be denied that the same public opinion which placed these two great branches of the national service under the conduct of the State, eventually—although exercised, according to the circumstances, in a more limited sense—decided upon the principle to be applied to gas supply. That principle may be accepted as a maxim of good government; for it declares that profit derived from indispensable monopolies should revert, not to individuals, but to the community by which it is contributed.

Having succeeded to the possession of these flourishing undertakings, corporations at once become the objects of a most touching solicitude. The greatest anxiety is manifested as to their deportment under the trying, albeit not unpleasing embarrassment of a balance on the right side. "What will they do with it?" is the inquiry from all quarters. What they ought to do with it is, according to the opinion of an influential section of their critics, clear enough. Of course, it is somewhat dogmatically asserted, they ought to apply it to a reduction of the price of gas; and so much satisfaction seems to be derived from this doctrine, that any appearance of disregarding it is visited with severe reprobation. Now, I do not happen to be one of those who conceive it to be within the province of the officials to tender advice as to the disposal of gas profits. That is a matter which may very safely be left to the discretion of the representative bodies, who are answerable to their constituents for their financial policy. Our chief, not to say sole duty, lies in the pursuit of means for the attainment of the most economical ends. Our satisfaction is derived from the achievement of results. It is our privilege to create—at all events in a very great measure—the situation from which it is the task of others to work out a more or less satisfactory deliverance. But every individual may have something to say upon such a topic, and most of all we who have thrown in our lot, so to speak, with the fortunes of gas enterprise; while it is not unnatural that our opinions should be biased in favor of the policy which promises most for the extended use of gas. So remotely, however, does it concern us whether the object of the corporation to sell gas at cost price or to relieve the rates, that in our official capacity, the course that appears to me to be most properly ours is one of non-intervention.

Especially will this be felt when it is recollected how varied are the conditions that must affect the decisions of the local authorities, rendering almost nugatory any definition of a general principle, and also how absolute is the control of the consumers themselves. They, in fact, are the masters of the situation. They constitute a large and influential majority of the ratepayers. They have it in their power to impose their will upon the management of the gas supply. They may, if they choose, legislate solely in the direction of their own immediate interests. They may, and frequently do, determine to supply themselves at the lowest possible price, regardless of the interests of that larger constituency in which is numbered every householder and every owner of property within the limits of the township to which they belong. I cannot but think that it is creditable in them, when other councils prevail, when they acknowledge their indebtedness to the wider constituency of which they form the greater part; when they recognize the claims of the property which has been pledged for their benefit. For it can hardly be denied that if there be any advantage in corporation management, it is by virtue of the machinery of self-government, of which the ratepayers are the components, thus brought into more active exercise.

The economies by this means made possible are, some of them, more indirect than apparent, although on that account none the less real; while others are tangible enough. There is, for example, the comparatively trifling one effected by the substitution of unpaid committees for paid boards of directors; but a far more important one is that which arises out of the easier terms upon which the necessary capital can be raised by means of the security of the rates. The difference between the cost to the companies of their capital, and the interest at which corporations are enabled to place their loans—or, in other words, the difference in value, according to public estimation, of the two kinds of securities—is in every instance considerable, although varying with circumstances. Take, for example, the case of the Metropolis. According to the latest published accounts, the entire share and loan capital of the four remaining companies supplying gas within its limits, as represented by its market value, amounts in round figures to 20¼ millions sterling, which will be found to yield to investors an average return of 5½ per cent. On the other hand, Metropolitan Board of Works' stock yields only a trifle over 3⅛ per cent., and this may be safely taken as the rate at which any new loans could be negotiated. The difference beteen this and the average interest upon the gas stock is 2⅜ per cent., which, upon the capital of the companies, represents a sum of no less than £493,806 per annum, or 6.5d. per thousand cubic feet upon the gas sold. Doubtless this is a somewhat extreme case, the difference in the provinces being usually less marked; while, as a matter of course, it is impossible that any similar saving could be effected as the immediate result of a change of ownership. But it indicates a way by which corporations might, if they chose, and if the law permitted them, participate in the profits of these undertakings, and even secure a certain amount of control over them without incurring the responsibilities of sole ownership—namely, by the investment, within certain limits, in gas stocks, of funds raised upon the security of the rates, after the manner of similar investments in docks or other public works of a remunerative character.

Whether such a course, as recently proposed, in fact, by the Metropolitan Board of Works, upon the application of a water company for additional capital, would tend to the satisfactory settlement of what is still, to some extent, a vexed question, it is probably not yet entirely beyond the reach of events to determine. The main purpose, however, of this reference to the Metropolis is to exhibit the nature and possible extent of an economy rendered practicable only by the action of the ratepayers; and toward which the consumers, as such, are in no sense contributors. In common fairness, then, it seems only right that some return should be made to the former; and yet, when the consumers, of their own free will, as is abundantly manifest, from their numbers and influence, elect to be equitably taxed in recognition of their obligations to the responsible owners of the undertakings, the cry is raised, ostensibly in their interest, although clearly not with their concurrence, that they are being treated unfairly and oppressively, in the manner contrary to the principles that should guide the councils of the Municipalities.

I know it is argued that corporations have no right to make profits, and, if I am not mistaken, the opinion of more than one high legal authority has been expressed to this effect. I hope, however, that it will not be considered presumptuous in me if I ask—By what law is this expressly forbidden? Is it held to be contrary to the letter, or to the spirit only of our statute books? If to the letter, then it is plain that the remedy is a weapon that can at any time be wielded with effect against the corporations; but if to the spirit, then I venture to suggest that this is susceptible of more than one interpretation. It is not at all difficult to agree with the limitations that have for their object the prevention of competition between public corporations and private traders, although the latter are generally secure enough in the hands of the constituencies. Nor is it easy to conceive of parliamentary sanction being extended to corporation enterprise undertaken for the sole and ostensible purpose of profit; but clearly a distinction must be drawn between profit that might be so derived and that which may accrue from the performance of a necessary public service. For instance, any endeavor to extend the operations of the Government savings bank or life insurance systems is sure to meet with opposition not wholly confined to the interests most immediately affected; and one can understand, if not appreciate, the jealousy with which such innovations are regarded. They interfere somewhat with the course of private enterprise, which, in matters of this kind, it is not absolutely essential, however desirable it may be to the public welfare, should be displaced by or be put into competition with the State. But I do not suppose that there is to be found one British taxpayer who grudges the Government the surplus revenues of the post office. I will go further, and say that there is not one in ten who does not wish that the annual profit from this source could be increased tenfold, consistently with the maintenance of equal public facilities. The reason for this is not far to seek. The monopoly enjoyed by the post office interferes with no one. It accomplishes that which not any amount of competion could improve upon. In no other transaction in life is the taxpayer secure of such a cheap pennyworth, or, I should say, halfpennyworth. And in no other way could the expenses of the State be more easily and imperceptibly met. The Chancellor of the Exchequer, who may hereafter devise so facile—I had almost said charming—a method of augmenting the national revenues, will well deserve the gratitude of his countrymen.

But, it will be asked, "What has this to do with the question of gas profits?" My reply is, that in the disproportion that exists between the value of the service rendered and the almost nominal charge for such service, the case of the post office is not entirely without a parallel, since, in nearly every instance, gas lighting is worth intrinsically much more than is charged for it. The ordinary consumer knows very well that he cannot replace it with its equal for convenience and economy. It would require, indeed, a very considerable advance upon present prices to put in jeopardy, or even to render uncomfortable, the existence of any gas undertaking of moderate importance. By a kind of fictitious value—if I may employ the adjective to express a meaning the reverse of that which is its generally

accepted one—has been imposed upon gas by means of the restrictions to which from time to time its purveyors have had to submit. It is true that these restrictions are to be regarded in some degree as in substitution of competition; but it is also true that they have operated more favorably to the consumer than the keenest competition that ever existed amongst gas undertakings. In the hands of corporations these limitations as to profits disappear or become inoperative, because in lieu thereof there arises a most effectual barier against abuse in this direction—I refer to the public voice. And when that voice declares itself in favor of the policy of insuring a moderate profit upon the gas supply—such profit to be devoted to the extinguishing of corporation indebtedness, or to the relief of the rates, or to any other purpose affecting the general interests of the entire community—I for one, not only fail to discover any impropriety in its utterances, but am fain to regard these as evidences of sound judgment and political capacity.

It is not to be inferred from these observations that I desire to be understood as seeking to defend the making of profit as a primary, or even as an inseparable object. On the contrary, it appears to me impossible to doubt but that there is between the positions of a company and a corporation an essential difference; the avowed purpose of the one being that of gain, while that of the other should be the common good. In this view it follows that wherever the administration of a corporation is conceived in an absolutely commercial spirit, there the full significance of the movement which placed the gas supply in their hands has not been grasped. In the pursuit of a successful balance sheet, quite as much as under the influence of what is styled "officialism," there is the temptation to be resisted of imposing restrictions such as are unknown in ordinary commercial transactions, the tendency of which is to narrow the circle of consumers, and to withhold from the masses of the constituencies those blessings of cheap light and heat which it is in the power, and ought to be the valued privilege of their representatives to dispense with a prudent and liberal hand.

Other considerations affect us yet more nearly. It must be admitted that, as regards the extension of the uses of gas and the progress of its manufacture, an additional stimulus has been imparted by the aspirations of the local authorities, because these, whatever form they may assume, inevitably furnish the strongest possible motives, not only for increased consumption, but also for intelligent and economical management. Not that corporations are at all singular in these respects, thanks to the tendency of modern legislation, although no instance has yet been supplied of progress made by a company working under the provisions of the sliding scale, at all comparable with that which, during a corresponding period, has been achieved by some few corporations. Neither has the pursuit of economy by corporations been uniformly attended with the happiest results, for reasons that are sufficiently intelligible; but it is none the less true that these acquisitions, by establishing a practical identity of interests between producer and consumer, have marked the commencement of a new era in the economical advancement of gas lighting. At the same time, and bearing in mind the instances in which corporation management has been upon its trial for a tolerably lengthy period, it is not to be denied, be the cause what it may, that if the course of gas manufacture has, during the past few years, been marked by any real improvement, little, if any, of this is attributable to the action of corporations. It has, indeed, been urged against them that their profit-making proclivities have led them to ignore improvements which, when in opposition to the companies, they had regarded as essential to the interests of the consumers; although, if I might offer to this accusation the reply that is dictated by my own experience, I should give it an emphatic and unqualified denial. I cannot, in fact, conceive of a more vigorous surveillance than that which is exercised on behalf of the consumers by a vigilant corporation in the ordinary discharge of its functions; nor of a more sensitive regard for the wants, and I might almost go so far as to add the fancies of their customers.

Those who are inclined to condemn corporations because occasionally complaints are made against their administration, or in opposition to the majority, would do well to remember that the atmosphere of free discussion, whether through the medium of the public press or in the council chamber, is as essential to the life and vigor of municipal as to that of national government. It no more follows, because corporations do not succeed in pleasing everybody, or in eliminating every source of complaint, that therefore they must be pursuing a mercenary and arbitrary policy, than it is to be inferred from the existence of an active opposition in Parliament that the government of the day is not acting with a zealous regard for the well-being and in harmony with the wishes of the majority of the nation.

As instancing the slender grounds upon which such criticisms are sometimes based, may be mentioned the controversy with regard to purification from sulphur compounds. How often has it been pleaded, as a reason against the observance of a high standard of purity by companies, that corporations are in the habit of neglecting such observance. Yet what are the facts? Is it not a fact that agitation upon this question has been almost exclusively confined to the Metropolis? Is it not a fact that no instance can be cited of a corporation or a local authority having deliberately abandoned the standard of purity which they had been the means of enforcing against their predecessors? And is it not also a fact that in at least one conspicuous instance recently the corporation has itself taken the initiative, and become earnest in their endeavors to improve upon the method of purication which they may be said to have inherited from the former proprietors of the works?

If we should seek for other reasons to account for paucity of initiation on the part of corporations, one such reason may probably be deduced from the estimation which the public has learned by degrees to attach to the art of gas manufacture. As the appreciation of the article itself has increased, so the respect for the methods of production may be said to have declined. "Gas making," it was observed to me not long since, "is a very simple process." "It appears so," was my reply, "until one begins to know something about it." Does not this little episode faithfully reflect the current of intelligent public opinion on the one hand, and on the other the common experience of gas makers? To men of real scientific culture our manufacture has appeared so absurdly simple that it is impossible to say how much it may have suffered from their neglect; while to others it has also appeared so simple that in our time there have never been wanting volunteers to remind us of our shortcomings, and who know so much better than ourselves how to conduct the business of a gas undertaking with economy and success.

It is not needful to recall to your recollection the recent discussion upon a subject that is, without doubt, of increasing importance to all dwellers in large towns—namely the avoidance of smoke as a means of preventing fogs—as illustrating the extent of unconscious misconception that unfortunately prevails, in otherwise well-informed circles, with regard to the economies of gas manufacture.

With this misconception we are all of us sufficiently familiar. Encouraged as it has been by the almost uninterrupted prosperity of the companies during a long series of years, it has assumed a variety of phases, and has been attended with consequences most diverse. Gas proprietors have been led to seek for their dividends as the result mainly, if not entirely, of a series of ordinary commercial transactions. They have been content, for the most part, to know that their materials have been purchased in the cheapest and their products sold in the dearest markets. This feeling is likely to be intensified in the case of corporations, because they would be predisposed to regard gas manufacture as pertaining to the nature of an exact science. Their justification as possessors of these works would be incomplete if the extraction of coal could be looked upon as a speculative industry; or, indeed, as being attended with anything short of an almost absolute immunity from risk. Consequently it is not at all surprising that corporations should bring to the discharge of their duties as gas purveyors a desire for improvement, it is true, but for such improvements only as may have received the sanction of experience and tradition. Nor is it any less surprising that, under the influence of a susceptibility to criticism, which is at once the strength and the weakness of popular institutions, this disposition to narrow the purview of their administration should survive long after a more intimate acquaintance with the details of the manufacture not only will have made it apparent how much is dependent upon practiced and intelligent supervision, but must also have suggested how much is anticipated from observation and research, stimulated and sustained by a higher knowledge of scientific truths. If this much can be said in extenuation of what, speaking as a matter of course, in a general sense, and certainly not from my own idividual experience, may be described as the prevailing tendency of corporation influence, is it unreasonable to expect that a more just appreciation of the art and of its resources will follow upon the advancement of public spirit, and an increased sense of responsibity with regard to municipal affairs.

If proof were desired of the uncertainties by which even the most experienced gas makers find themselves to be surrounded, or if we should wish to know in what directions it is likely that profit and advantage will accrue from the encouragement, not alone of a spirit of inquiry, but also of a higher standard of professional qualifications, we have only to turn to the chronicles of passing events. While, for example, it is a matter of common knowledge that temperature controls the principal operations comprised in gas manufacture, and governs their economy with an almost absolute force, how lamentably small, in comparison with its acknowledged influence, is our stock of reliable data as to its effect under varying conditions. Probably this was never made more apparent than during the discussion that followed the publication last autumn, in the columns of the *Journal of Gas Lighting*, of the article by Mr. George Livesey, on the "Economy of Carbonization." Started by the enunciation of a proposition not very far removed from elementary, in its conclusion it was felt that nothing had been concluded. It embraced, perhaps, a much wider range than had been contemplated by its originator, and yet the most conspicuous feature of it

was the scarcity of the facts, in support of the ideas, which it elicited. Nevertheless, it served a very useful purpose by bringing into convenient juxtaposition opinions representative of the most opposite of proclivities. Speaking broadly, on the one side was sought to be disparaged the exercise of scientific skill in carbonizing; while on the other its importance was as stoutly maintained. It does not seem possible to extend toward the former view any great amount of sympathy, but it is not to be denied that, in existing circumstances, there is much that is favorable to the arguments by which it was supported. It is not the premises so much as the conclusions arrived at by its advocates that seems to be at fault.

In these fortunate times, when not unfrequently the entire cost of the coal is covered, or nearly so, by the value of the residuals, it would appear upon first thought to be a very small matter indeed, in comparison with the ready saving that may be effected by a judicious selection of materials, whether the return per ton be 500 feet more or less; and when the higher result is only to be obtained by the employment of a more expensive material, whether of coal or cannel, or a mixture of the two, it ought not to be very difficult to decide upon its comparative economy. Assuming, as we may do for all practical purposes, that the value of the residuals remains the same, the issue in such a case is narrowed to one of difference between the increase in cost of material on the one hand, and the saving effected in labor, wear and tear, and interest on capital outlay for retort plant on the other—both calculated at per thousand cubic feet produced. Certainly, when purchasing coals, it will not do to rely upon a high yield of gas, to the exclusion of other considerations, because the almost invariable concomitant of this is a disproportionately increased price; and hence it will be found, more often than not, that the most economical all-round results have been secured by the use of the cheapest suitable material, although in doing so the gas manager may have to run the gauntlet of criticism of no enviable kind. As a matter of course, there are reasonable limits to this, as there must be to every method of selection, which each one may be left to define for himself, according to circumstances,—such, for instance, as the value of coke in his particular locality, or the distance from it to the coal field—but upon the broad question of principle, I apprehend that there is little room for difference of opinion. To base our selection of coals solely upon their ascertained commercial value for gas making purposes, and not with an eye to carrying on a kind of competition with our neighbors for the greatest make per ton, is neither more nor less than to assert our claim to the exercise of an untrammelled judgment upon matters of vital importance to the prosperity of a gas undertaking; and, as such, is secure, I venture to think, of a ready and complete acceptance.

With this general agreement, however, our difficulty with regard to the views under consideration may be said to commence; the correspondence having made it clear that the tendency to undue reliance upon commercial instinct is not altogether confined to the comparatively uninitiated. But what does it amount to? That benefit has followed, and is likely still to follow, the assertion of what is, after all, little more than an implied principle of good management, no one will care to dispute; but that this justifies a diminished respect for skill applied in the retort house, few, I trust, will be disposed to admit. On the contrary, it could scarcely be a difficult matter to show, by illustrations derived from current experience, that the familiar and oft-quoted axiom, that "dividends are made in the retort house," is, in the warning and encouragement it contains, as true to-day as it undoubtedly was true when first uttered. At all events, the opposite opinion may be accepted as an unconscious and, on that account, most valuable tribute to the average excellence of modern carbonizing arrangements, for this alone could induce so happy a feeling of confidence in results under all conditions. But by what means has this excellence been attained? Do we not know that it is not the achievement of a day or of a year, but that it has been built up by continuous and persistent effort, by patient attention to details and observance of effects? It is, of course, quite possible that our labor may have been expended for naught; or, rather, that it has been pursued in this direction at a sacrifice of other advantages; but if a comparison of results should make it clear that the reverse has been the case, ought we not to derive from it encouragement to fresh enterprise, and confidence in following the lead of those who may claim to have established a further and perhaps more notable advance?

Most of us will have the materials for such a comparison ready at hand. Individual experience must be the best guide to future action. And will not this experience, more often than otherwise, furnish a record of steady progress in the attainment of what were at one time held to be next to impossible results? How frequently has it not happened that each succeeding year has been marked by an improvement in the make per mouthpiece, or in the yield per ton, with a proportionate diminution in the charges for labor, and with little apparent addition to the fuel account, or falling off in the receipts for residuals. It is, however, only reasonable to suspect that to such economy there must be a limit. Our perplexity is to find out this limit, which does not appear to be reached by the exhaustion of our resources for the prevention of waste. You cannot, it has been said, with an assumption of practical wisdom, get more out of a ton of coal than there is in it. We should be in a position to appreciate the observation better if we knew exactly what a ton of coal is capable of yielding, or it might even be regarded as the perfection of truisms if only we had arrived at a knowledge of the precise methods by which the most economical results are to be secured. But these are still the objects of our search. We continue to be in doubt as to whether the tendency of a higher heat is to increase the volume of gas at the expense of its quality, or whether it is to be considered simply as a means for quickening production; and also as to its influence upon the formation and composition of tar and of impurities.

These are all questions which are involved in so considerable an amount of obscurity that only a few facts concerning them are at all plainly discernible. One of these, however, is of primary importance. That rapid production may be compassed in a remarkable degree by the application of a high heat, is in perfect accord with common experience; but that deterioration in quality does not follow as as necessary consequence has not been by any means so generally accepted or understood. The opinion of Dr. Schilling, therefore, upon this point is deserving of our most careful consideration, because it is that of one who has devoted much time and attention to the study of this subject, and also because it is indorsed in a very practical manner by nearly every other leading gas engineer in Germany. Go almost where one will in that country, evidences are to be met with of a deeply rooted faith in the efficacy of high heats, and this can only be accounted for by the circumstance that no such deterioration is found to ensue. Dr. Schilling, indeed, is careful not to claim for the system with which he has so successfully identified himself, any greater merit as regards the point under consideration, than that of improving the production per retort; but others, both in this country and elsewhere, are not slow in ascribing to it still higher virtues. According to these, it affects favorably not only the productive capacity of the retort house, but also the yield, or the quality, or both, of the gas produced. Further evidence as to this, which, to be conclusive, should embrace the commercial value of the resultant tar, is much to be desired; but in the meantime the negative testimony, if such it may be called, of the German gas makers, supported as it really is by the results thus far of our own practice, cannot but be accepted as satisfactory by those who are desirous of emulating their achievements.

In one particular—namely, in the saving of retort space—the advantage of high heats, as developed by the generator system of firing, is so obvious as scarcely to call for special remark. I am, however, tempted to bring under your notice one out of several illustrations of it which I met with during the autumn of last year, because it happens to bring into contrast two systems of retort management, the least advanced of which cannot be said to have received general recognition amongst us. At Dresden the new works in course of construction were originally designed with settings of six retorts, the furnaces being adapted for what has been called "hard firing," and the yield relied on 6,000 cubic feet per mouthpiece. But in the interval which not unfrequently occurs between the conception of an undertaking and its commencement, the Engineer to the Municipality (Herr Hasse) had been able so completely to satisfy himself of the practicability and comparative economy of the generator system, that settings of nine retorts each, heated by generator furnaces, one to every two settings, in place of six, and occupying only the same ground space as the latter, were eventually determined upon. The yield from these is estimated at 8000 cubic feet per mouthpiece, or, per setting, exactly double that which was formerly obtained, and upon which the previous estimate had been based; the net result being that the retort houses, as now constructed, while of the same productive capacity, are only about one-half the size that was at first thought necessary. It is evident what a relief the establishment of this system might prove to be in some of our overcrowded works, where it might tend to prolong the life of plant, the productive capacity of which has already reached the ordinarily accepted limits.

The influence of temperature upon the formation of impurities, amongst which ammonia may be reckoned, is a study that has hitherto been all but neglected; and yet how much might it not be found to contribute to a settlement of the comparative economy of high and moderate yields. It is not without value to know, for instance, that carbonic acid is evolved most rapidly at the commencement of a charge, when the heat within the retort is at its lowest; while carbonic oxide is formed in increasing abundance as the charge becomes worked off, and the heat is proportionately greater. But it might prove of much more importance, by putting it into our power to lighten the labor and cost of the subsequent process of purification, if we did but know, with anything like distinctness, the conditions most favorable to the formation of sulphur compounds. Above all, the production of ammonia is in the highest degree worthy of investigation; not alone on account of its rising value as an article of commerce, but also because of the hopes that are very properly based upon its adaptability as a most facile purifying agent. It is not by any means certain that the combination within the re-

tort of the two elements of which ammonia is composed is beyond our control; recent experiments tending to show that this is accelerated by high heat, or, at all events, that by far the largest proportion of ammonia is produced towards the end of the process of distillation. This, if confirmed, would furnish an additional argument in support of what may be called the "advanced" method of carbonizing; and, in conjunction with other considerations of no less weight, affords reasonable grounds for inferring, that the position taken up by the defenders of that which is now styled a moderate, but which not so long ago was looked upon as a high heat, is, to say the least of it, by no means impregnable.

In quite another direction this uncertainty about temperature still pursues us; but this time it is not the attainment of effect by its means, so much as the means by which heating effect may be attained, that form the objects of our search. During the last few years the heating properties of coal gas have come to be extensively recognized, and its advantages in this respect are regarded as no mean security for the permanence of our industry. It is, consequently, of growing importance to determine the correct principles upon which heating appliances ought to be constructed, in order to obtain from them a maximum effect; but there are indications of danger to be apprehended from overrating the resources of science to this end. It is evident that no good can possibly result from an undue exaltation of the heating properties of coal gas; nor can anything but serious mischief result to the cause we all have so much at heart, from the dissemination, however unintentional, of inflated hopes. With the object of avoiding this, it is above all things desirable that the heating power of coal gas should be definitely ascertained; and we may therefore hail with considerable satisfaction the promise of authoritative information held out to us by the papers of Dr. Adams and F. W. Hartley.

Now, in the choice of a stove, or in deciding upon the details of its construction, we may very properly address to ourselves this rudimentary proposition:

What are its functions? Is it to be considered as a means for developing or increasing the heat afforded by the combustion of gas, or must it be regarded simply as an instrument by which we are enabled to control the heat for our purposes, and carry off the products of combustion? I apprehend that only one answer to this is at all possible, or is capable of being sustained. There cannot be more than one source of heat, and that is the combustion of the gas; though whether its development is favored by one burner more than another may, to some extent, be an open question. But as regards the apparatus itself there is little room for conjecture or uncertainty. It may be made to assume any possible shape, or be so contrived that its full thermal effect takes the form of a current of heated air capable of being measured with the greatest exactness; and yet its superiority over other appliances, depending for their effect to a greater extent, perhaps, upon the ordinary means of radiation, will not have been made manifest.

It is by no means clear that any ordinary burner, employed for the purposes of illumination, will not produce a greater heating effect, proportionate to the consumption, than the most elaborate gas stove than has yet been produced. In a certain room, for example, there is a gas-fire and a three light chandelier. The gas-fire is a modern contrivance, although I do not instance it as a model of economy, for it consumes 34 feet per hour; the chandelier is fitted with burners of a very common kind, consuming together from 12 to 14 cubic feet per hour. A higher temperature is produced in the room—more than double the effect, in fact—by the chandelier alone than by the gas-fire alone; in other words, the latter requires fully five times as much gas as the former to produce the same result. This is scarcely difficult to account for. The position of the gas fire against one side of a square instead of in the center counts for something in favor of the chandelier; then there is the absorption of heat by the sides and back of the fire, most of which is lost for useful effect; but more than all, there is the inevitable large percentage carried away with and by the products of combustion. This explanation is so simple as to be scarcely worth mentioning, were it not for the lesson that it teaches, and which is so frequently lost sight of. With the chandelier, as a matter of course, the whole of the heat is given off within the room, and consequently the highest economical result is obtained; but with this attendant drawback, that the products of combustion are not got rid of.

In the construction of a stove, then, the object that should be aimed at is to render available as large a proportion as practicable of the heat, by carrying off the products of combustion with the smallest percentage of loss. With this end in view, economy in design is usefully promoted by the application of the principle of an induced current of air, after the manner of an annular condenser; and this appears capable of extended application. In the highly important work of house ventilation, for instance, it is probable that a very wide field is open for the employment of coal gas, because, by its means, this is susceptible of easy and satisfactory accomplishment. What are the conditions of efficient ventilation? They are, that the vitiated air shall, by some continuous process, be withdrawn and replaced by an equal supply of fresh, without inconvenience to the occupants of the apartment or dwelling. Ordinarily, as we know, this is a matter that is left entirely to chance, fresh air being regarded as an intruder to be kept out—in cold weather at any rate—at all hazards. But this need not be. No one will dispute its value, if it can be admitted without injury or annoyance. A Ritchie, or any stove of similar construction, is capable of being turned to admirable account for this purpose. All that is required is to connect the vertical air tubes alternately at the top and bottom with pipes leading to the exterior of the building. When this is done and the stove lighted, two air currents will be set in motion, one proceeding inward and delivering fresh air, warmed in its passage through the stove, and the other outward, expelling air that has become vitiated. Mr. Lawson Tait, of this town, has recently introduced a very simple modification of this arrangement, suggested, I believe, by what is known as the "Tobin" tube, and which is capable of being most cheaply and at the same time very effectively applied. It will be found described in Mr. Tait's pamphlet on "Bedroom Ventilation," a little work which is deserving of study by all who are interested in extending the use of gas.

Suggestions have been made for increasing the heating power of gas by raising the temperature of the air supply, though whether, in this respect, any analogy exists between gas combustion and the process of gas making, in which the introduction of a hot blast has proved so eminently successful, is at present a matter of almost pure speculation. Less doubt, if anything, surrounds the action of hot air in the development of illuminating power; but even with regard to this the evidence has hitherto been conflicting. Recently, however, attention has been directed to the regenerative burner of Herr F. Siemens, of Dresden (samples of which, I may mention, are to be seen at the Windsor Street works), by which most important results are said to be achieved. We shall hail with infinite pleasure any confirmation of them, as indicating an entirely new departure, the significance of which it would be difficult to overestimate.

It is not surprising that the increasing appreciation of the convenience of fuel in a gaseous form should lead to the revival of proposals for the supply of a cheap gas to be used exclusively for heating purposes; and it may not be altogether futile to imagine it as one of the resources open to gas makers, by which the periodical embarrassment arising out of large accumulations of coke may be avoided. It is not, however, to be expected that the anticipations of success indulged in by the advocates of these products can be fully realized. The prospect of a duplicate system of mains, services, and fittings is repugnant to our notions of economical distribution, although finding favor, if I am rightly informed, on the other side of the Atlantic. One powerful objection, likewise, is to be found in the fact that coal gas is already in almost every house, and every consumer has it in his power to help forward that good time to which we are to all appearance hastening, when it shall be applied with economy to all the purposes for which heat is required. Every penny per thousand feet taken off its price increases its chances of permanent employment in this direction, and removes it to a less measurable distance from competition with carbonic oxide. Apart from this, however, the subject is an important one, too, from its bearing upon the details of our manufacture; and we are therefore fortunate in being able to look forward to its treatment this evening by one of its greatest and most distinguished authorities.

While continuing in doubt as to the practicability of such projects, of which probably during the next year or two we may hear more, they furnish a hint which need not be lost sight of in the ordinary process of gas making. Dr. Wallace has proposed that this should be supplemented by means for the separation of the gases given off toward the end of the charge, which are admittedly of much less value for lighting than for heating purposes. The provision of duplicate hydraulic mains, with valves for reversing the current of the gas at a given period, would seem to introduce a most undesirable complication of plant, and, for other reasons, is clearly inadmissible for the end Dr. Wallace has in view; but it points to a way by which the quality of the gas might be completely controlled without recourse being had to any expensive enriching material. In substance, the idea bears some resemblance to that which formed the subject of an unsuccessful patent taken out in this country about four years ago, but in its present more practical shape it is said to have been applied at some German works; the gas issuing from the secondary hydraulic main being separately condensed to extract from it the valuable tar and ammonia, and then utilized in the retort furnace. It is not unreasonable to expect that economy should result from such a method skilfully applied; although not likely to recommend itself to those whose first consideration is a large yield of gas per ton of coal carbonized.

The lamented death of Mr. F. J. Evans, who was a member of this Association, which occurred shortly after our visit last year to the grand works with which his name is inseparably associated, has severed a prominent connecting link between the past and the present of gas manufacture. His long professional career embraced a period fruitful in events of a permanent

and decisive character, in the shaping of which he bore a distinguished part. The history of the company with which he was for so many years officially connected has been a somewhat chequered one. The struggles and vicissitudes in which he participated were essentially such as are everywhere to be met with upon the road to solid and enduring success; the ultimate triumphs in which he shared were the fitting rewards of sagacity and enterprise.

Perhaps of all the changes that occurred during his time, the one possessing the most abiding interest for us is that which he was mainly instrumental in effecting. The transference of the manufacture of gas to a distance from the Metropolis was conceived in a happy moment for the fortunes and prestige of his company, and not less happy was the manner in which it was carried into effect.

The works at Beckton have been justly designated "the most magnificent establishment of the kind in the world;" and if our admiration at the skill that is everywhere displayed in them should have a tinge of disappointment, this mingled feeling will not have been engendered by any sense of incongruity or incompleteness. It will have been occasioned solely by the unwelcome conviction, brought home to us with all the impressiveness of magnitude, of the apparent hopelessness of seeking for any radical improvement in gas making appliances, having reference chiefly to retort-house plant. Here, it may be said, is unlimited scope, manufacture upon a gigantic scale, and every inducement to a new and economical departure; but this has not been taken. Yet ought we, even in the face of such overwhelming evidence, to acknowledge its impracticability, or cease asking ourselves why it is that, while in every other direction advances continue to be made commensurate, or nearly so, with the enlargement of our operations, retorts, within the limits of a few inches in size, remain the same; our largest works being, in this respect, little more than a multiplication of such as are infinitely less, and possessing over them little or no advantage in point of economy of production.

Can it be that every alternative has been tried, or that none is possible to the present costly method of carbonizing more applicable to the large quantity of coal with which we are now accustomed to deal? Some will say that machinery is a remedy; but machinery, at its best, leaves much to be desired. Is there nothing to be learned from kindred industries? We know, for example, that the manufacture of metallurgical coke, in which the labor per ton of coal is infinitely less than in that of coal gas, is becoming assimilated to the latter; the gaseous product from the coke oven being treated, as regards exhausting and condensing, in much the same way as are those from a gas retort. I do not go so far as to say that a coke oven, even of the most approved kind, such as is employed in several parts of France, and in its earlier form by the Paris Gas Company, would be found applicable in its entirety to gas making, or that other considerations, into which it is now impossible to enter, may not outweigh that economy of labor. But it might offer a clue to the direction in which improvement might be sought. At all events, it seems only reasonable to suggest that we cannot too soon or too intimately become acquainted with methods so nearly allied to our own, if we are sincerely desirous of reducing a most considerable and wasteful item of the present cost of gas making.

I had hoped that time would permit me to say something upon other subjects of no less importance and interest. Notably that of purification in closed vessels is one towards which hopeful glances continue to be directed, although sustained as yet by little substantial encouragement. Still, the different processes that during recent years have been presented to our view point to something more than a mere repetition of former failures. They are unmistakable evidences of an increasing spirit of inquiry, and go far to show that this most desirable reform is not beyond the reach of skill and enterprise, and that no one need despair of its ultimate accomplishment.

But I must not further pursue these tempting topics. I am anxious, by way of conclusion, to direct your attention to a widely different matter—to a work which, a few years ago was commenced, under the auspices of the Association, at the instigation mainly of one of our Past-Presidents, Mr. W. J. Warner, and which has since moderately prospered. It will be remembered that considerable objection was, upon various grounds, taken to the formation of the Benevolent Fund. It was believed to be unnecessary, or that it might to some extent inspire the needs which it was intended to relieve. But the cases that were speedily brought under the notice of its committee effectually disposed of these objections, and it soon became apparent that a much larger income than was available could be usefully and beneficially dispensed. Accordingly, measures were taken to give greater prominence to the fund, with the gratifying result, last year, of a substantial increase in the amount of subscriptions. This has enabled the committee to provide a larger measure of relief for the ensuing year, though not so large as would be justified if their income could be felt to be of a more permanent character. To impart to it this desirable permanence, it is hoped that the fund will henceforth enlist the support of a greater number of subscribers. It has no ambitious programme to fulfil. Its work has no pretensions to that of a life insurance or provident institution. It is not for the encouragement of the improvident, neither is it for the benefit of the intemperate or the careless; these have no claims upon our sympathy. But when misfortune has done its work—when, perchance, the breadwinner is struck down without having had the opportunity of providing for those who are dependent upon him; or when the storms of adversity have broken upon a head bowed by the weight of years—then, to the home of the desolate, or to the couch of the weary, speeds our message of comfort and of healing.

[Translated for the AMERICAN GAS LIGHT JOURNAL.]

The Efficiency of Generator Furnaces.

The May number of the *Journal fur Gasbeleuchtung* contains a highly interesting article by Dr. H. Bunte, in which he discusses the results of a series of observations on the working of generator furnaces, which were made during September of 1879, at the works of the Frankfort Gas Light Company, at the instance of the manager, Mr. S. Schiele.

We reproduce a portion of the rather lengthy paper, taking this opportunity, however, of recommending a careful study of the entire article. It illustrates the thorough manner in which German gas managers conduct investigations of this character, and it may, indeed, be made to serve as an admirable guide in similar work.

The objects of these investigations were to study, in the first place, the action of the bench and of its furnace as a whole, to ascertain the carbonizing capacity and economic efficiency, the losses in the several parts, to observe the draught, determine the temperature at various points of the bench, and to arrive at a knowledge of the chemical composition of the generator and waste gases.

The bench which was thus subjected to experiment had eight retorts of the usual dimensions, and arranged in the manner customary in Germany. It was provided with a generator furnace on the Liegel system, and was fired with coke from Saar coal, having the following composition:

Carbon	83.9	per cent.
Hydrogen	1.2	"
Ash	10.9	"
Oxygen and sulphur	4.0	"

The coke yielded 11.8 per cent. of a slag which flowed freely from the slit when the auxiliary grate was used.

During these tests the furnace was in every respect in average working condition, and both of the adjoining benches were in action. The total amount of coal carbonized per 24 hours was 6,000 kg.; the coke consumed per 24 hours was 1,080 kg., equivalent to 18 per cent. of the weight of coal carbonized.

The following is a *resume* of the average results as observed:

I.—*Generator.*

a. Composition of generator gas—

Carbonic acid	6.4	per cent.
Carbonic oxide	19.1	"
Nitrogen and hydrogen	74.5	"

b. Temperature of furnace not ascertained.

c. Draught, .57 inch water.

II.—*Bench.*

a. Composition of products of combustion:

1.—With excess of air—

Carbonic acid	16.0	per cent.
Oxygen	3.4	"
Nitrogen	80.6	"

2.—With deficiency of air—

Carbonic acid	16.9	per cent.
Carbonic oxide	3.5	"
Nitrogen	79.6	"

b. Temperature of bench—

1. At crown of arch	1416° C.
2. In outlet flue	1129° C

c. Draught—

Right side, .56"; left side, .41".

III.—*Temperature of Air Supply.*

In air flues, 515° C.

These data enable a more detailed discussion of several interesting points.

I. The furnace consumed per 24 hours 1,080 kg. of coke, or, deducting ash, 950 kg.

II. Volumes of air and gas. The composition of the gas from the generator shows that one cubic meter contains, of gases having carbon as one of the constituents, $0.064 + 0.191 = 0.255$ cu. m.

Now, 0.5364 kg. of carbon is required in the production of one cubic meter of CO or CO_2; therefore every cubic meter of the generator gas requires the expenditure of $0.255 \times 0.5364 = 0.1368$ kg. of carbon; and hence 1 kg. of coke (considered as carbon only and exclusive of ash) yields 7.31 cubic meters of gas.

The formation of 1 cubic meter of gas of the above composition necessitates the supply of $1 - 0.191 \div 2 = 0.904$ cubic meter of air. Every kg. of coke, therefore, required $7.31 \times 0.904 = 6.61$ cu.m. of air.

The generator, therefore, consumed $950 \times 6.61 = 6280$ cu.m. of air in 24 hours.

III. Heat developed. The number of heat units produced for every cu. m. of the generator gas was as follows:

0.064 cu.m. CO_2 yields $0.064 \times 4334 = 277.376$ units.
0.191 cu.m. CO " $0.191 \times 1327 = 253.457$ units.

530 833 units.
or about 531 units.

The calorific value of 1 kg. of carbon when transformed into CO_2 is 8080 heat units; hence 1 cu.m. of the generator gas, containing 0.1368 kg. of carbon, has a heating value of $0.1368 \times 8080 = 1105$ heat units.

The generator which developed 531 heat units, therefore, yielded 48.1 per cent. of the total heat.

IV. Temperature of the generator gases. If no heat were lost by radiation and conduction, the initial temperature of the gas from the generator would be 1686° C., as the following calculation will show. In order to raise the temperature of the gaseous mixture one degree there are required—

For the CO_2 — $0.064 \times 427 = 0.027328$ units.
CO — $0.191 \times 327 = 0.058637$ units.
N — $0.745 \times 307 = 0.228715$ units.

0.314680 units.
or about 0.315 units.

Hence, 531 thermal units would raise the temperature $531 \div .315 = 1686°$ C. It was not possible to ascertain this very high temperature by means of an ordinary pyrometer. It is very evident that the heat radiating from the red hot coke would tend to increase this temperature; if it had been possible to intercept this heat and measure the temperature of the furnace, it would have been found to be considerably lower than 1686°. Much of the heat is lost by radiation through the slit, and is carried off with the slag, while some is lost by radiation and conduction through the brickwork, and a portion is utilized for heating the air supply of the bench.

V. The process of combustion in the bench. Chemical analyses showed that combustion took place under varying circumstances as to the air supply.

1st. When there was an excess of air in which case the products of combustion contained 3.4 per cent. of free oxygen.

2d. When there was a deficiency of air, and the waste gases contained 3.5 per cent. of carbonic oxide.

These variations in the composition of the products of combustion were at first attributed to the varying thickness of the bed of coke in the generator, and the consequent varying resistance to the passage of the air; but special investigation upon this point revealed the fact that this influence was but very slight as compared with the influence of the condition of the slit in the bottom of the generator. It was found that the percentage of unconsumed CO in the products of combustion was 3 per cent. just after the slit had been freed from slag; 25 minutes afterward it had become reduced to 1 per cent.; when, after 15 minutes more, the slit had been quite reduced in width, 1 per cent. of pure oxygen was found; and after a further lapse of 0 minutes the amount of oxygen had risen to 3 per cent. At this time the slit was cleared of slag, and the furnace gases again showed a percentage of carbonic oxide.

The case in which there is an excess of air is first discussed. Calculation shows that the probable theoretical composition of the products resulting from the combustion of a generator gas having the given composition, and with an excess of air, is as follows:

Carbonic acid	15.8	per cent.
Oxygen	3.3	"
Nitrogen	80.9	"
	100.0	

which agrees very closely with that actually observed, and thus testifies to the accuracy of the conclusions to which the present investigations have led.

One cu.m. of generator gas requires for complete combustion 0.095 cu.m. of oxygen, or 0.454 cu.m. of air, theoretically. The excess of oxogen of 3.4 per cent. requires an additional amount of 0.258 cu.m. of air; so that there is supplied in all per cu.m. of gas 0.712 cu.m. of air. Hence the production and subsequent complete combustion of 1 cu.m. of generator gas requires a supply of 1.616 cu.m. of air, 0.904 cu.m. of which enters the furnace through the slit, while 0.712 cu.m. enters the combustion chamber through the air-heating flues. In other words, 56 per cent. enters through the furnace proper, while 44 per cent. enter at the oven; 28 per cent. of the latter is necessary, theoretically, to effect complete combustion, while the remaining 16 per cent. represents the excess of air which was actually supplied. If, instead of basing these calculations upon one cu.m. of gas, they are predicated upon one kilog. of carbon, the amount of air to be supplied is 11.8 cu.m., since a cu m. of generator gas contains 0.1368 kg. of carbon.

Now as to the heat given off by the generator in raising the temperature of the air supply of the bench. It was shown above that for every cu.m. of generator gas consumed, 0.712 cu.m. of air was supplied. The temperature of the air was found to be on an average 515° C.; hence the amount of heat which was absorbed in effecting this increase in temperature was $0.712 \times 515 \times 0.31 = 113.67$ thermal units.

The heat developed in the generator per cu.m. of gas was found to be 531 heat units; hence there still remain 417.33 thermal units. In other words, of the total heat of the generator gas, 21.5 per cent. was absorbed by the air flues, while 78.5 per cent. yet remains, though, it is true, a portion of the latter is lost by radiation and conduction. The amount of this loss can not be exactly ascertained, since the mean temperature of the furnace could not, as already stated, be determined. The air flues, however, which occupy but a portion of the sides of the generator furnace, take up 21.5 per cent. of the total heat. Hence it is not advisable to neglect entirely the losses just referred to. In the absence of more exact data, it is presumed that a loss equal to 5 per cent. of the total heat would not be too high, but rather less than the actual loss. On this assumption the loss for every cu.m. of generator gas is 56 units; so that $417 - 56 = 361$ thermal units still remain available.

Efficiency of Furnace. The combustion of 1 cu.m. of gas containing 0.191 cu.m. of carbonic oxide yields—

$0.191 \times 3007 =$	574 units.
Available heat in gas	361 units.
Available heat in air	114 units.
Total	1049 thermal units.

The temperature of the products of combustion is found as follows:

The gases contain 15.8 per cent. of CO_2 and 84.2 per cent. of nitrogen and oxygen; hence the number of thermal units required to raise 1 cu.m. 1 degree in temperature is—

For the CO_2 — $0.158 \times 0.427 = 0.067466$ unit.
For the N and O — $0.842 \times 0.307 = 0.258494$ unit.

0.325960 unit,
or about 0.326 unit.

Hence the 1049 units available by combustion of 1 cu.m. of generator gas will raise 1.617 cu.m. of the products of combustion to a temperature of

$$\frac{1049}{1.617 \times 0.326} = 1990° \text{ C.}$$

Of course, this is but a theoretical temperature, being based on the supposition that the combination between gas and air occurs instantaneously, so that no heat is lost or transferred to surrounding objects. In practice this initial temperature cannot be attained, since the brickwork and the retorts at once receive some heat. For the present purpose, however, it is immaterial whether the heat is utilized gradually or at once, so long as the process is thoroughly complete. The temperature of the bench was found to be on an average 1416° C. at the crown of the arch, the maximum being 1515°, the minimum 1350°. The highest temperature of the waste gases at outlet flue was 1300°, the lowest 950°, and the average 1129° C.

As already shown above, every cu.m. of the gaseous products of combustion required an expenditure of 0.326 unit to raise the temperature 1° C.; hence 1.617 cu.m., the result of the combustion of 1 cu.m. of generator gas, required $1.617 \times 0.326 = 0.527$ unit. The products of combustion, therefore, at an average temperature of 1129°, carry off $1129 \times 0.527 = 593$ units per cubic meter of generator gas. Now, 1 cu.m. of this gas yields 1049 units, as shown above; hence the bench absorbed $1049 - 595 = 454$ heat units which were useful in carbonizing the coal and supplying the losses due to radiation.

Summarizing these results, we have the following tabular statement of the manner in which the heat was generated and distributed:

I.—*Heat Generated.*

a. In generator,	531 units p. cu.m. gas	..	48.1 %	..	3886 units p. kg. carbon
b. In bench	574 " "	..	51.9 %	..	4194 " "
	1105 units p. cu.m. gas,		100.0 %	..	8080 units p. kg. carbon

II.—*Distribution of Heat.*

	Units per Cu.M. Gas.	Per Cent. of Total Heat.	Units per Kg. Carbon.
a. In generator—			
1. In generator gas	361	32.7	2642
2. In air supply	114	10.3	832
3. Radiation and loss	56	5.1	412
	531	48.1	3886
b. In Bench—			
1. Absorbed by retorts	454	41.1	3321
2. Waste through chimney	595	53.8	4347
	1049	94.9	7668
Heat utilized	454	41.1	3321
Heat lost	651	58.9	4759
	1105	100.0	8080

The efficiency, then, being 41.1 per cent., it appears that for every kilogram of coke, free from ash and considered as carbon, $0.411 \times 8080 = 3320.88$ units were utilized by the bench. There were used in 24 hours 950 kg. of coke; hence the bench absorbed per day 3,154,836 thermal units, and since it carbonized 6000 kg. of coal in the same time, it would appear that the distillation of one ton of coal required an expenditure of 525,806 thermal units, which covers all losses by radiation and conduction, and also the amount of heat wasted by the red hot coke.

(Concluded in next number.)

The Petroleum Outlook.

In examining the statistics, which we present in this issue, and comparing them with those of the preceding month, it will be found that the opinion which we expressed of the outlook in our last issue, is fully confirmed by the present figures of production in stock, shipment and market values.

Notwithstanding we have somewhat increased our shipments from the region during the month, we have added to our stock in the region over three quarters of a million barrels.

The daily average runs of all of the pipe lines has been 85,196 barrels; while the daily average shipments from all the pipe lines has been 50,433 barrels; and although by the large runs we have slightly decreased stocks at the wells, in wooden and iron tanks, yet taking all the figures together, our daily production for the month has exceeded our daily shipments from the lines by 26,770 barrels.

There has been a good deal of talk of a near approach of diminishing production. All hope founded on such talk is beginning to look delusive. Notwithstanding the obvious excess of supply over demand, which has prevailed for more than two years, the best figures obtainable show that the daily production in the month of June has increased 3,677 barrels over the daily production of the preceding month.

The developments in the Wellsville region have, during the month, been rather unimportant. Several of the ventures have come in, and are reported "very small producers," or "dry." The differing gravity of the oil leads many to infer a small and unprolific field. Quite a number of wells however are drilling at locations which are regarded as significant test points. Some of these will probably not be completed before July. With reference to the future fertility of this field, therefore, little or nothing can be promised at present.

A number of large companies and firms operating in the richer portions of the Bradford field, have formally agreed not to drill for the remainder of the year. If this agreement is faithfully adhered to by all concerned, it will probably have some effect towards decreasing the production of the Bradford field somewhat. Many agreements of a similar kind have been made at different times in the past, but there is, we believe, no single instance in which such agreements have been carried out to the end. Meanwhile, in spite of over-production and stagnant market, the statistics of "drilling wells," "wells completed," and "rigs up," show great activity throughout all the region.

With an average daily production of 77,203 barrels, which seems to be on the increase rather than on the decline, and with a surplus stock of over twenty-three millions of barrels, it would be altogether unreasonable to hope for an active, advancing market for crude, unless such activity comes through artificial speculation. That it is not likely to come from this cause is pretty evident, inasmuch as the speculators seem fully to appreciate existing conditions, and to have withdrawn almost entirely from the field.

Among all the gloomy surroundings there is but one hope for better prices, and that hope is based upon the fact that the stocks in Europe are considerably lower than they were this time last year, and that the demand for export oil, in the coming four or five months will, consequently, be quite large. We may thus be relieved of our burden temporarily, by getting better prices for a short time; but so far as permanent relief is concerned, it looks very much as if our only way to healthy conditions at the producing end of the line, lies through the self-created bankruptcy of the energetic producer.—*Stowell's Petroleum Reporter.*

Gas Engines at the Frankfort Opera House.

It is announced that, in order to guarantee the Opera House at Frankfort from all danger of fire, there have been established in the basement of a neighboring building two pumps capable of raising 66,000 gallons of water per hour to a height of 60 feet. The motive power for these is furnished by two Otto gas engines of 50-horse power each, placed beside the pumps, and driving them by means of a shaft with friction gearing, which permits of one or both of the engines being worked at a time. During the period of representation within the house, one of these motors is kept slowly running out of gear so that on the first alarm being given a very few seconds only need elapse before all the machinery is in action. The consumption of gas for both engines when in full work is about 2540 cubic feet per hour; when out of gear it is only about 175 cubic feet per hour for one engine. The gas service pipe is six inches in diameter, reduced to 4½ inches after branching off to the first engine.

There is no special meter employed for this service, but a counter is provided to register the number of times gas is admitted to the cylinders, the volume of which was previously determined. The cylinders are cooled by a supply of water under pressure, the warm water returning to the reservoir.

The products of combustion are taken away by a common pipe which communicates, through a depositing chamber, with the outer air. These are said to be the largest gas pumping engines in existence, and their faculty of being instantly available, before steam could be raised in the best steam fire engine boiler, is held to compensate for the additional cost of working during the brief periods for which they alone would be required.

They are said to give much satisfaction, and the theatre going public have great confidence in the safeguards from sudden fires thus provided.—*Journal of Gas Lighting.*

Experimental Determination of the Velocity of White and Colored Light.*

By Dr. J. Young, F.R.S., and Professor G. Forbes.

The method employed in this research to measure the velocity of light resembled the method of M. Fizeau, subsequently employed by M. Cornu. A revolving toothed wheel is employed in the same way to alter the intensity of the light reflected from a distance. In the present method, however, there are two distant reflectors instead of only one. They are separated by a distance of a quarter of a mile. The observing telescope and the two reflectors are almost in the same line. The observer sees two stars of light, which go through their phases with different periods as the toothed wheel is revolved at increasing speeds. One star is increasing, while the other is diminishing, in intensity, with increase of speed of the toothed wheel. The speed required to produce equality of the lights is determined by means of a chronograph.

By choosing such a speed as gives a maximum of one star at the same speed as a minimum of the other, a pair of observations eliminates all cause of doubt arising from varying brightness in the stars, and ratio of the width of a tooth to the width of a space. The distances were observed by triangulation with the Ordinance Survey theodolite, using as a base line a side of one of the Ordinance Survey triangles. The source of light was an electric lamp. The velocities (uncorrected for rate of clock, and reduction to a vacuum) measured are as follows:

187,707
188,405
187,676
186,457
185,788
186,495
187,003
186,190
186,830
187,266
188,110
188,079

Mean.... 187,167 miles a second.

The correction to vacuum is +54 miles a second. The correction for rate of clock to a mean solar time is +52 miles a second.

The final results for the velocity of the light from an electric lamp *in vacuo* is 187,273 miles a second, or 301,382 kilometres.

* Abstract of a paper read before the Royal Society, March 10, 1881.

Using Struve's constant of aberration 20.445", we obtain for the solar parallax the value 8.71", and for the mean distance of the sun 93,223,000 miles.

On February 11th, 1881, the reflected stars were seen to be colored, one reddish, the other bluish The particular color of a particular star depended upon the speed of rotation of the toothed wheel. That star which was increasing with increase of speed of the toothed wheel was reddish, that one which was diminishing with increase of speed was bluish. This seems to be caused by the fact that blue rays travel quicker than red rays.

A number of tests were made to judge of the accuracy of this conclusion, and they confirmed it. In the final arrangements, the electric light was acted upon by a bisulphide of carbon prism, and part of a pure spectrum was used. Differential measurements were then made to find the difference in velocity of rotation of the toothed wheel, required to produce equality of red and of blue lights. The most convenient method was to use a driving weight slightly in excess of that required to produce equality of the light, then to fix to the pulley carrying the weights one end of a piece of stout india-rubber tubing, the other end being fixed to a point above. This gradually diminished the effective driving weight. The equality of red lights was first noted, the color of the light was changed, and the interval of time until the blue lights were equal was measured. The rate at which the india rubber diminished speed was afterwards measured by the aid of a chronograph, and thus the difference of speed determined. The mean of 37 determinations in this and other ways, gave the result that the difference in velocity between red and blue lights is about 1.8 per cent. of the whole velocity, blue traveling most rapidly.

The general conclusion seems to be supported by a comparison of the velocity of light measured by M. Cornu and Mr. Michelson, where the source of light usually employed is taken into consideration. These are the only measurements of the velocity of light hitherto published. They give us the following results:

	Usual source of Light.	Velocity in kilos. a Second.
Michelson's research....	The sun near horizon	299,940
Cornu's "	Lime light	300,400
The present "	Electric light	301,382

Classifying the sources of light used by Cornu, we get the following approximate relative velocities:

Source of Light.	Number of Observations.	Approximate Relative Velocity.
Petroleum.....	20	298,776 kilos.
Sun near horizon.....	77	300,242 "
Lime light.....	449	300,290 "

All these results seem to support the view that the more refrangible the source of light, the greater is the velocity. But the evidence of the present observations, indicating an excess of velocity for blue over red light, seeming to exceed one per cent. of the whole, must rest upon the merit of the present observations themselves.—*Chem. News.*

Unfamiliar Qualities of Charcoal.

Among the numerous and varied properties possessed by charcoal there is one—one, too, of the most wonderful—which does not seem to be adequately recognized, probably from its being imperfectly known, except by physicists. It is that of being able to condense and store away in its pores many times its own bulk of certain gaseous bodies, which it retains, thus compressed in an otherwise unaltered condition, and from which they can be withdrawn, as required, as from a reservoir.

That eminent scientist, M. Saussure, undertook the task of a systematic examination of this subject, with a result which will prove surprising to the general reader. Operating with blocks of fine boxwood charcoal, freshly burned, he found that by simply placing such blocks in contact with certain gases, they absorbed them in the following proportions—

	Volumes.
Ammonia	90
Hydrochloric acid gas	85
Sulphurous acid	65
Sulphuretted hydrogen	55
Nitrous oxide (laughing gas)	40
Carbonic acid	35
Carbonic oxide	9.42
Oxygen	9.25
Nitrogen	6.50
Carburetted hydrogen	5
Hydrogen	1.75

It is this enormous absorptive power that renders of so much value a comparatively slight sprinkling of charcoal over dead animal matter as a preventive of the escape of the odors arising from decomposition. A dead dog having been placed in a box in the warm laboratory of an eminent chemist and covered with charcoal to the depth of between two and three inches, could not be discovered to have emitted any smell during several months, after which time an examination showed that nothing of the animal remained but the bones and a small portion of the skin. To the large excess of oxygen over the nitrogen in the atmosphere, which, according to the above table, was absorbed by the charcoal, and which thus rendered harmless the noxious vapors given off by the carcass as they were being absorbed, is doubtless owing to the fact above stated, and the further fact of the charcoal never becoming saturated.

In a box or case containing one cubic foot of charcoal may be stored, without mechanical compression, a little over nine cubic feet of oxygen, representing a mechanical pressure of 126 pounds to the square inch. From the store thus preserved the oxygen can be drawn by a small hand pump.

From the fact of the charcoal absorbing oxygen in so much greater proportion than nitrogen, we have here a means of utilizing its discriminative powers of selection in obtaining unlimited supplies of oxygen from the atmosphere, which contains nitrogen five times in excess of its oxygen, or 20 per cent., whereas by the separating or selective powers of the charcoal the mixed gases capable of being extracted from it contain over 60 per cent. of oxygen. It only suffices to withdraw this now highly oxygenized air into another vessel of charcoal, by the further exposure to which the proportion of oxygen will be increased to a still greater extent. This indicates a most feasible means by which atmospheric air can be decomposed in such a way as to provide a cheap supply of oxygen.

One cannot readily recognize the fact, which is nevertheless true, that the condensing power of charcoal, as applied to ammonia, is equal to what would be obtained by subjecting this gas to a pressure of nearly 1,260 lbs. on the square inch.—*Sci. News.*

Coal Dust and Colliery Explosions.

Seeing that the *Journal* is the only paper that brought under the notice of mineowners and engineers the effects of coal dust in connection with explosions, pointing out the means by which it could be rendered comparatively harmless, before its importance was officially or practically recognized, we are glad to find that our views on the subject have to the fullest extent been recognized and endorsed by Professor Abel, after a series of interesting and valuable experiments made at the request of the Home Secretary in relation to the Seaham disaster.

For the first time at an inquest upon bodies of men killed by a mining explosion the nature of coal dust as an explosive agent has been determined by one of our ablest scientists, and it is to be hoped that the evidence given at the Seaham inquiry by Professor Abel will not be overlooked or forgotten by those having the management of mines, and at the same time we would again draw attention to the danger attending shot firing in mines that are known to give off gas, and where coal dust is continually moving about. Coal dust in some mines is far more sensitive than it is in others, owing to physical peculiarities. In nearly all instances, however, it not only promotes and extends explosions, but may be brought into operation as a fiercely burning agent, conveying flame as far as its mixture with air extends, so becoming an explosive agent when coming in contact with an amount of gas which without it would not be at all dangerous.

Coal dust, indeed, goes off in some instances the same as gunpowder, and this can be seen by throwing some on to a red hot fire, so that in case of a shot the floating dust can be easily ignited, and this appears to have caused the explosion at the Seaham Colliery; and we are told that the proportion of fire-damp required to bring dust in a mine into operation as a rapidly burning or exploding agent, even upon a small scale, and with the application of a small source of heat or flame, is below the smallest amount which can be detected in the air of a mine even by the most experienced observer with the means at present in use.

The danger attending shot firing in a dry mine, where quantities of dust are floating in the air, has been fully shown and commented upon by ourselves on several occasions.

Professor Abel also says that dust, in the presence of considerable heat and flame, such as a blown-out shot or an overcharged hole, would constitute a small proportion of fire-damp, the possible existence of which in the mine might not in the least be suspected, they serve as the exciting cause to the development of an explosion of fire-damp. With a large volume of flame, and the great disturbing effect of a blown out shot, as the initiating cause of the ignition of dust, and its suspension in the surrounding air, such inflammation may in the complete absence of fire-damp be propagated to a greater distance than the results of small experiments would warrant our assuming, but at the same time it scarcely can be maintained that the air of a mine in which the coal gives off gas at all can be at any time free from fire-damp, so that the existence of very small and unsuspected quantities of that gas in the air of a mine may suffice to bring about the ready propagation of flame by coal dust and to develop violent explosive results.

From the experiments made it appears that 2.5 per cent. of gas in a cur-

rent in which the most sensitive of the Seaham dust was suspended, passing a lamp or flame at only 600 feet velocity per minute, became ignited, and produced explosive results. There is, however, one point in connection with dust which appears to have been overlooked in the experiments made, and which we should have liked to have seen carried out—that relating to dust on the outside of the lamps. A good deal of dust gathers round a lamp, and it is probable that it becomes inflammable, so that the lights may be drawn through the gauze, and might readily ignite any gas that might be in the place, or the dust floating about might be ignited, and so spread along for some distance, until it came in contact with the explosive mixture.

There is, however, an easy method for rendering dust harmless, as we have shown in former notices, and it has been in force for a considerable time at the well-known Oaks Colliery, near Barnsley. The mine is a dry one, and the manager has had the roads and other places watered every morning, so that the dust could not float in the air, and at the Seaham enquiry it was suggested that before firing a shot the places around should be watered, so as to lay the dust. But to our thinking there would be far greater security were dry mines well watered daily, as is already the case at a few places. In most of our coal mines gas is given off in more or less quantities, and where there are fine particles of dust floating about, and shot firing is carried on, there will be danger. Such was the case at Seaham, according to several witnesses.

Mr. Atkinson, the assistant Government Inspector for Durham, who was one of the first to descend the mine after the explosion, gave as his opinion that it took place close to where a shot was fired, either just before or coincident with it. Two shots, indeed, had been fired almost together, and this was thought by some of the witnesses to have contributed to the explosion. Near to where one of the shots was fired the dust was found from 6 to 8 inches thick, and every angle and every projection had an accumulation upon it.

Prof. Abel said that the shot at one place, which it was assumed was the cause of the explosion, might have been a blown-out one, or it might have been an overcharge, and there might have been a flame propelled by it into the workings; there was a deposit of dust in a fine state in the immediate vicinity over the place where the shot was fired, and he conceived it possible that a quantity of the dust might have become inflamed, and the flame, assisted by some small proportion of fire-damp which might possibly have been travelling at a considerable velocity. In such a way foul air might have been met with and the explosion caused.

Dust, we say again, is an element of danger in mines, producing carburetted hydrogen, and the danger is intensified where blasting is the means for bringing down coal. The use of powder is more economical than wedging by hand, but under any circumstances where gas is given off it is not compensated for by the danger which is incurred as regards property and life. Still the many lives that have been lost owing to shot firing has not been as yet sufficiently deterrent to prevent its discontinuance in what are termed fiery mines.

The jury at Seaham viewed the whole question of the explosion in a very off-hand and easy manner, for it was left to those composing it to say whether, in their opinion, shot firing in stone, as at present carried out, was safe or required further safeguards or restrictions; and whether, in view of Professor Abel's comprehensive report on the probable connection of coal dust with explosions, it was necessary, for the safety of the men in the mines, to either water or remove coal dust. The jury replied, as to the firing of shots and the clearing away of coal dust, that they thought those matters might be safely left in the hands of the managers. This was certainly paying a high compliment to the managers, but we doubt very much whether it will be satisfactory to the mining body, or that portion of the public that has taken an interest in the inquiry, or in the important questions relating to blasting in mines and the dangerous nature of coal in a powdered state.

In dry mines we should most strongly advise the dust being watered, not only as a preventive against accidents, but for the sake of the health of the miners, for the inhaling of slack must be highly injurious.

This can be done in several ways. Messrs. Rogers, of Truro, patented a plan for taking down steam into mines for preventing accumulation of gas. The steam is taken from the surface and blown into the headings and other places where the gas is likely to accumulate, and by using the steam in small quantities during the day the coal dust would be precipitated, and kept so moist that it could not rise in the workings, and tend in any way to aid an explosion.

The invention is also applicable for keeping the dust down solely in mines, and the steam can be applied by means of a portable boiler, and taken to any place where where it may be required, either for the neutralizing of the gas, or laying the dust. The dangerous character of coal dust has now been fully demonstrated by the experiments made by Professor Abel, and the elaborate report he has made in connection with them; and it is therefore to be hoped that those in whose hands are placed the lives of thousands of miners will not be slow in taking the necessary precautions to prevent exposions from shot firing, gas, and coal dust combined.—London *Mining Journal.*

How to Render Wood Fireproof.

Mr. P. Folbarry has devised a method of making wood incombustible without, in any way, altering its outward appearance. Wood prepared in accordance with his process may possibly be charred just at the surface, but the heat to which it is exposed, though ever so intense, can never penetrate right into the wood and touch its fibers. Timber petrified in this way is particularly suitable for staircases that are to resist a conflagration. The composition devised by the inventor is as follows—

Fifty-five pounds of sulphate of zinc, 22 pounds of potash, 44 pounds of alum, 22 pounds of sesquioxide of manganese, 22 pounds of sulphuric acid at 60°, and 54 pounds of water. The whole of the solid substances are put in an iron vessel, containing water at a temperature of 113°F. When all this solid matter is dissolved, the sulphuric acid is poured in slowly until the whole is saturated with it.

The solution is now ready, and in order to prepare timber with it, the piece must be put on an iron grate in a suitable recipient, in accordance with the size of the pieces and the object for which they are intended; care being taken to leave half an inch between any two pieces. The composition is pumped into the recipient, and after the whole of the spaces have been filled up, it is left there in a boiling state for three hours. The wood is then taken out and placed on a grate-like wooden stand in the open air, to make it dry and firm.

When thus prepared, the impregnated wood may be used for shipbuilding, and building in general, for railway carriages, scaffoldings, posts, wooden pavements, and generally for all purposes where it is desirable that the material should be able to resist fire.—*Ironmonger.*

Glycerine.

Notwithstanding the low price which now prevails for almost every description of raw produce and manufactured goods, there are a few articles which form notable exceptions. Perhaps one of the most remarkable of these is refined glycerine, which, within the last two years, has advanced from about £30 to £130 per ton avoirdupois for 30°B. This enormous advance is due partly to increased consumption, diminished production, and the influence of speculation working on a market devoid of stocks. In view of the present position of the article and the prospect of a continuance of high prices for a considerable time to come, the attention of soapmakers is now being turned to the utilization of their waste "leys," and various new processes for recovering the glycerine contained in these liquors have lately been tried with more or less successful results. Apart from minor impurities, waste soap "leys" are generally found to contain glycerine, carbonate of soda, or caustic soda, chloride of sodium, gelatin and albumen.

One of the processes for recovering the glycerine which promises to be the most economical and the most successful begins with concentrating the liquor until the salts contained therein begin to crystallize. The liquid is then cooled and filtered to rid it of gelatine and albumen. It is afterwards made to absorb carbonic acid, which precipitates bicarbonate of soda, and which is separated from the liquor in the usual way. After undergoing this process the liquor is then made to absorb gaseous hydrochloric acid until what remains of carbonate of soda has been converted into chloride, and further, until all, or almost all, the chloride of sodium has been precipitated and separated from the liquor in the usual manner.

Arrived at this stage, the liquor contains water, glycerine, and hydrochloric acid. The acid is then evaporated entirely and absorbed in water for using afresh.

The dilute glycerine remaining can be purified by filtering it through animal charcoal or by concentrating and distilling it in the usual way.—*Glasgow Herald.*

Continental Iron Works.—The most encouraging move in the direction of weekly half holidays for mechanics is the action of Mr. Rowland, proprietor of the Continental Iron Works, who will give his men a half holiday every Saturday throughout the summer, and he believes, permanently. This is not to be done in deference to any strike or request, for none has been made. Mr. Rowland having seen English mechanics enjoying their Saturday afternoons, he would like to see his own employees do likewise, and he believes he will incur no loss by the change. Such an example is worth a hundred strikes.—N. Y. *Herald.*

Chinese Cement.—Shellac disolved in alcohol. Used for joining wood, earthenware, glass, etc.

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GAS LIGHT JOURNAL

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SATURDAY, JULY 16, 1881.

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34 PINE STREET, NEW YORK CITY.

JULY 16, 1881.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid.	Asked
Gas Co.'s of N. Y. City.				
Central	$466,000	50	60	65
Harlem	1,800,000	50	84	87
" Bonds	170,000			103
Manhattan	4,000,000	50	200	205
Metropolitan	2,500,000	100	147	155
" Scrip	1,000,000	..	102	103x
Mutual	5,000,000	100	70	75
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	170	175
" Bonds	750,000		106	110
New York	4,000,000	100	102	104
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	116	120
Citizens	1,200,000	20	45	50
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	60	65
Peoples	1,000,000	10	35	40
" Bonds	290,000	.	101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	60	65
Nassau	1,000,000	25	55	60
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	60	65
" Bonds		...	98	103
Kings Co	135,000	100	55	60
" Bonds	40,000	—	—	—
Richmond Co., S. I.	300,000	...	70	75
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	180
Consolidated, Balt.			58	60
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	155,000	40	117½	
Jersey City	750,000	20	145	155
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	153	154
New Haven, Conn		25	132	—
Oakland, Cal			32	33
Peoples, Jersey City		...	95	100
" " Bds.				5
Pittsfield, Mass			120	130
Rochester, N. Y.		50	70	80
" Citizens		100	30	35
Woonsocket, R. I.	150,000	100	80	...
Wilmington, Del.		50	174	...
Yonkers		50	30	32
Rondout & Kingston			75	80
St. Louis Missouri	600 000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			68	69
Toledo, Ohio			95	97
Troy, Citizens	600,000	100	—	—
Washington, D. C.	1,500,000	20	130	200
" Scrip	500,000	20	150	160

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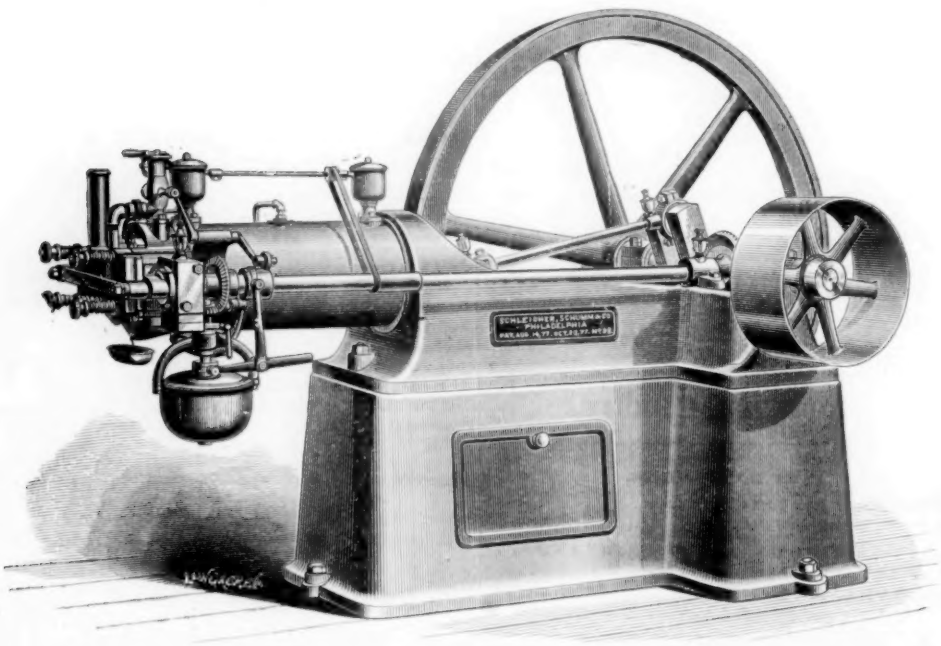

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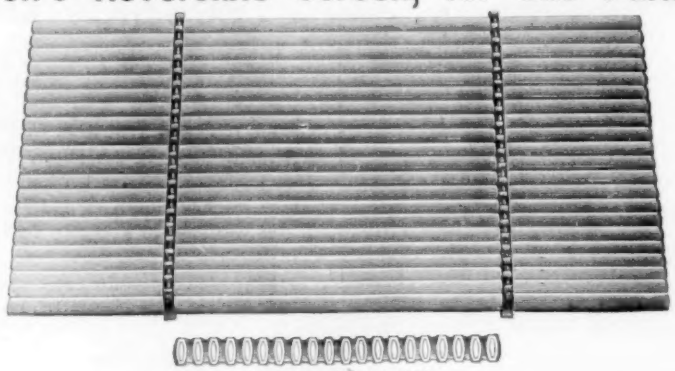

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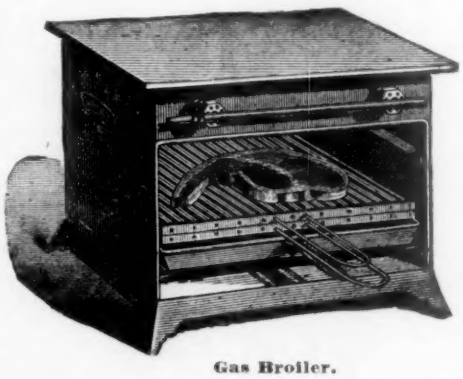

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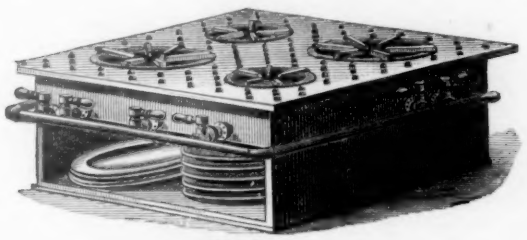

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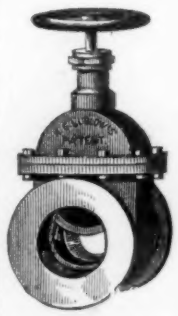

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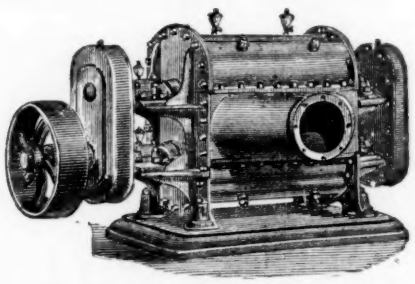

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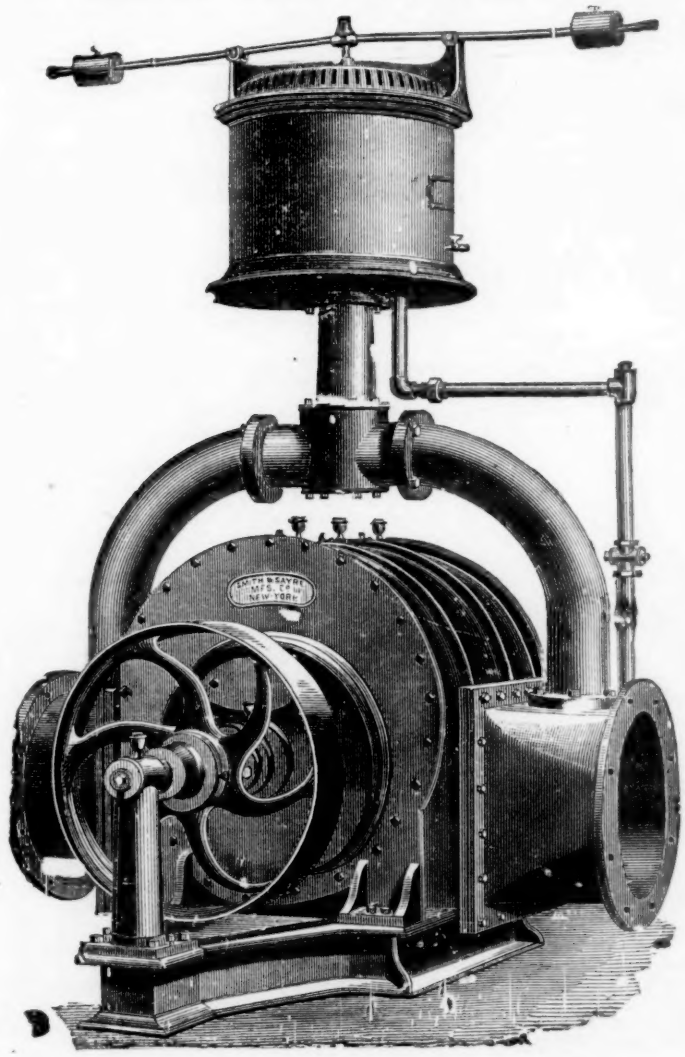

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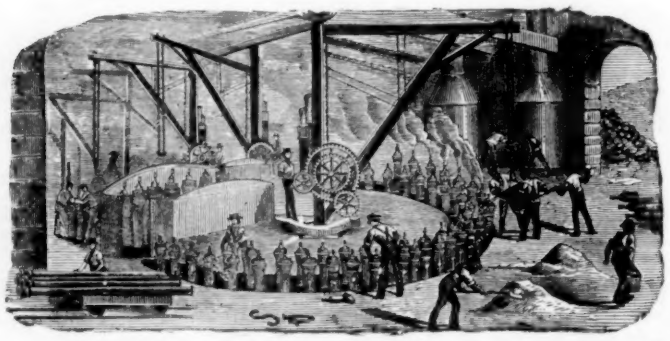

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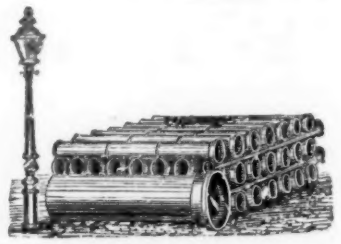

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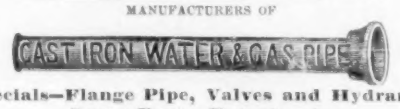

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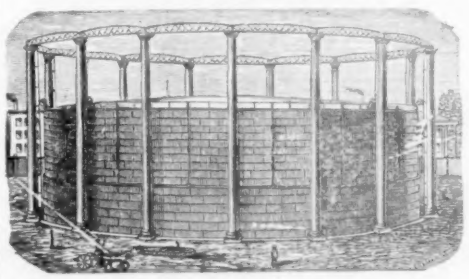

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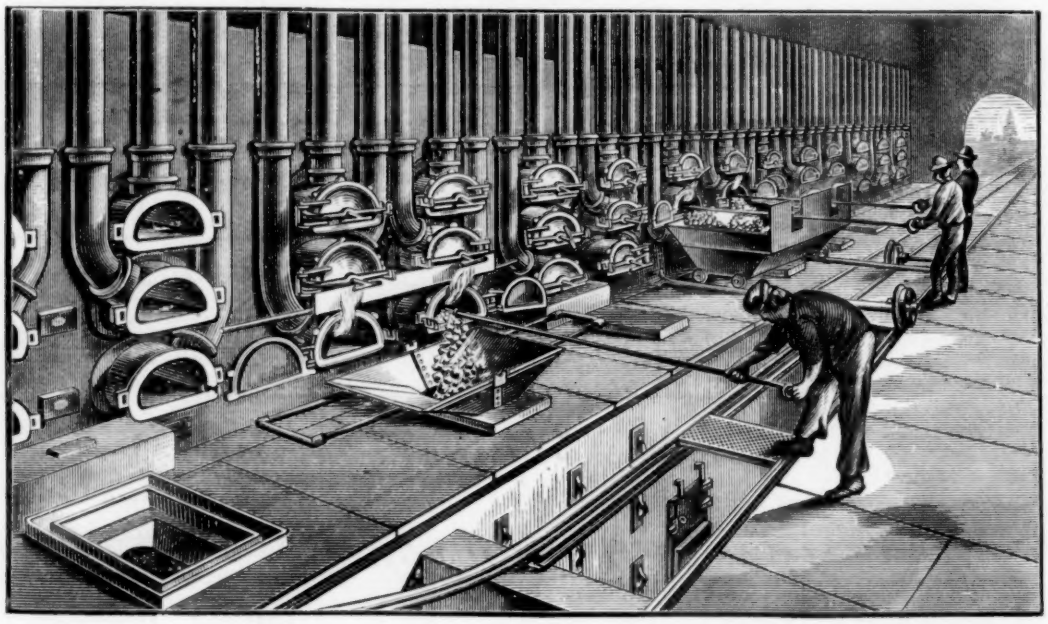

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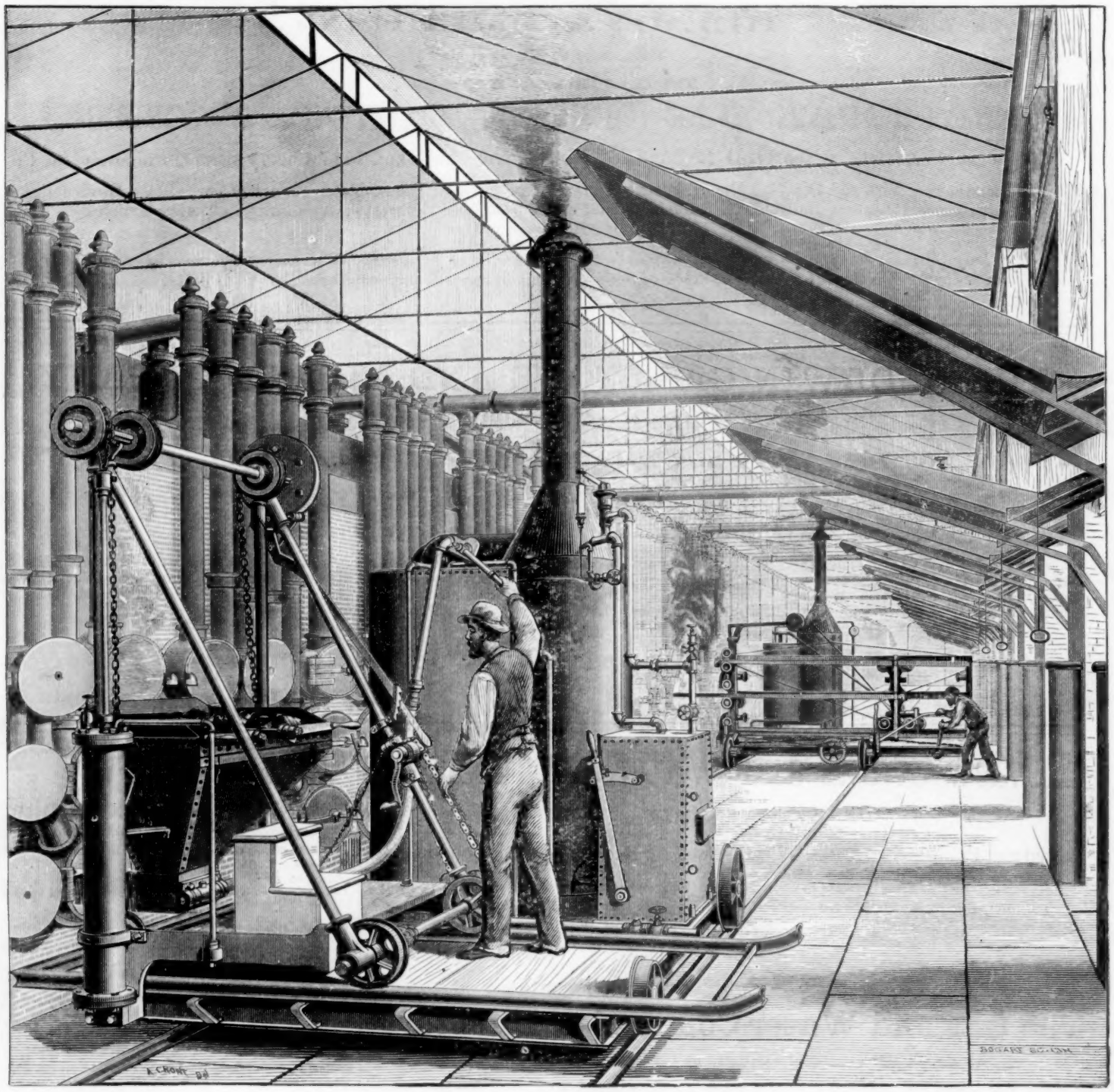

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